AMRAD NEWSLETTER

Amateur Radio Research and Development Corporation August 1981

AT OUR AUGUST 2 MEETING Hal Feinstein, WB3KDU will speak on packet radio network top-down strategies. Hal harbors the idea that you should first decide what you're trying to accomplish before you design something. The meeting will be at 7:30 P.M. at the Patrick Henry Branch Library, 101 Maple Ave E, Vienna, VA. At 9:00 P.M. the library closes, and there is an informal gathering at the Pizza Hut which is located at 2539 Chain Bridge Rd in Vienna.

QEX: THE ARRL EXPERIMENTERS' EXCHANGE will be the title of a new American Radio Relay League publication to start in December 1981. A call for articles (and columnists) is being sent out in the August issue of *QST*. The deadline for the December issue is October 25. All articles and other items should be sent to *QEX* editor, Paul Rinaldo, W4RI, 1524 Springvale Ave, McLean, VA 22101. Editing, production and mailing will be handled in McLean, VA. However, all applications for subscriptions must be mailed to ARRL Headquarters, 225 Main St, Newington, CT 06111. Subscriptions are available to ARRL members at $6 for 12 issues. For nonmembers, the rate is $12 for 12 issues. The foregoing rates apply only to subscribers with mailing addresses in the U.S. and possessions. Canadian and Mexican subscribers must add $1.74 and will be serviced by First Class mail. Overseas subscribers should add $6.78 for air mail or $2.34 for surface mail. The rates are quoted in terms of 12 issues because the frequency of publication may change. The plan is to start every other month and move to monthly publication as soon as there is enough material flowing in. ARRL members are asked to include their membership control number (or a mailing label from their *QST* wrapper) when requesting subscriptions.

Readers will notice a family resemblance between *QEX* and the *AMRAD Newsletter*. While the *AMRAD Newsletter* has focused to some extent on packet radio, spread spectrum and telecommunications for the deaf, *QEX* will be covering a wider range of interests of Amateur Radio experimenters. The fact is that the serious experimenter will need both publications to keep up with what's going on.

QEX will be the place for technical articles that are too perishable, too technical, too specialized, etc. for publication in *QST*. While the ARRL staff may refer some material of this type from *QST* to *QEX*, the whole idea is to generate new material for *QEX*. We know that there's a lot of experimenting going on in Amateur Radio and that much of it is not written up. Maybe the experimenter is too busy to write. Possibly he/she is frustrated with rejection from magazines which must cater to a general audience. We don't see *QEX* as siphoning off material that might have gone to *QST*. On the contrary, a not-so-polished article in *QEX* might lead to another in *QST* when the experimentation is further along.

Support from AMRAD members in launching this new publication is invited. If you are thinking of a technical article on almost any subject within Amateur Radio, try to get it in shape by October 25. Shorter material in the form of correspondence to the editor is also welcome.

AMPAD'S TREASURY is groaning again, due to inflation catching up with us, the high level of service offered members (a bigger newsletter, repeater maintenance, etc.), and the lack of a fund-raising event since 1978. Your board of directors will be considering an increase in dues and some type of fund-raising project. Meanwhile, you can help by signing up new members using the membership application at the end of the newsletter. Now may be a good time for you to consider life membership, which is a real bargain (look what other organizations are asking for life membership). Also, please consider cash donations to AMRAD which is a non-profit organization. Contributions to AMPAD are tax-deductible per ruling of the Internal Revenue Service. If you're redoing your will, keep us in mind!

SPREAD SPECTRUM

Hal Feinstein, WB3KDU
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703-524-9116 home

There has been some new activity at the FCC regarding spread spectrum. The Commission has taken a step forward with the idea of integrating spread spectrum techniques into civilian radio technology. The FCC releases are printed in this newsletter.

10-METER FREQUENCY HOPPING

Experiment #2 has been progressing at a good rate. The two CB transceivers that were acquired by Hal, WB3KDU have been modified for 10 meters, and some work has started on the hopping controller board.

A review of the divider capabilities of the 858 synthesizer chip leads us to believe that about 467 separate channel frequencies are possible. There is also a pin which is used for establishing a channel aeparation reference. Usually this is set for 10 kHz separation which is used in CB. Five kHz is also available from this chip, which may be better for hopping purposes.

While adjusting the synthesizer stage we ran into an interesting kind of feedback. When the synthesizer stages are not tuned properly, sometimes you would get motorboating sounds in the audio. As you increased the frequency, the pitch of the motorboating would increase. In transmit mode, with a frequency counter hooked to the transmitter, we found that these motorboating sounds were a result of the synthesizer being out of lock. The results read on the frequency meter showed that the transmitter output was jumping all over the hf spectrum.

There is a special circuit in most synthesized CB rigs which will kill the transmitter if the synthesizer selects a frequency outside the normal CB channels or if the synthesizer is out of lock as would happen when you are changing channels. This circuit is supposed to prevent out-of-band operation. One of the first steps in some conversion procedures is to cut out this circuit. Some people want to use these things out of band.

The direction that manufacturers have taken in the newer synthesizer chips for CB is to build a ROM (read-only memory) with the correct channel settings directly on the synthesizer chip. Then if there is an unlocked or out-of-band signal generated, an on-chip shutdown circuit is activated to cut the output of the chip.

This motorboating can be cured completely by simply adjusting the various tuned stages in the synthesizer to their proper values. Then the circuit operates without any motorboating over the entire range of ten meters.

One of the members of our group, Chuck Phillips, W4EZV (ex-K5LMA) has been playing around with a small range frequency hopper that has a dozen or so channels in it. It was designed to hop on the 2-meter band and uses standard tone decoder/encoder chips for much of the preamble and control work. The unit itself is small, and Chuck says that it doesn't draw much power. He also has a receiver that goes along with it. More later.

Joe, K4IHP sent in a circuit for dealing with the problem of "hard agc" which crops up in conventional superhet frequency hopping rigs. Dick Kessler, K2SZE sayd that it resulted from the fact that the AGC is sensitive to strong QRM on some channels. On one channel there is strong QRM and the agc responds by lowering the gain. When you hop to another channel without QRM the agc is too slow to recover in time. This results in the loss of an audible signal for a few hops, until the agc recovers. K4IHP has devised a solution to this problem for fre quency hopping rigs where the number of channels is low. (See following page.)

Notes:

1. Buckets can be expanded cheaply in multiples of 16.

2. To conserve the number of buckets, closely spaced frequencies can use the same bucket. This will happen automatically if you use just the high-order address lines of the synthesizer address lines.

3. Cheap CMOS analog multiplexor chips can be used. (Try RCA.)

continued→

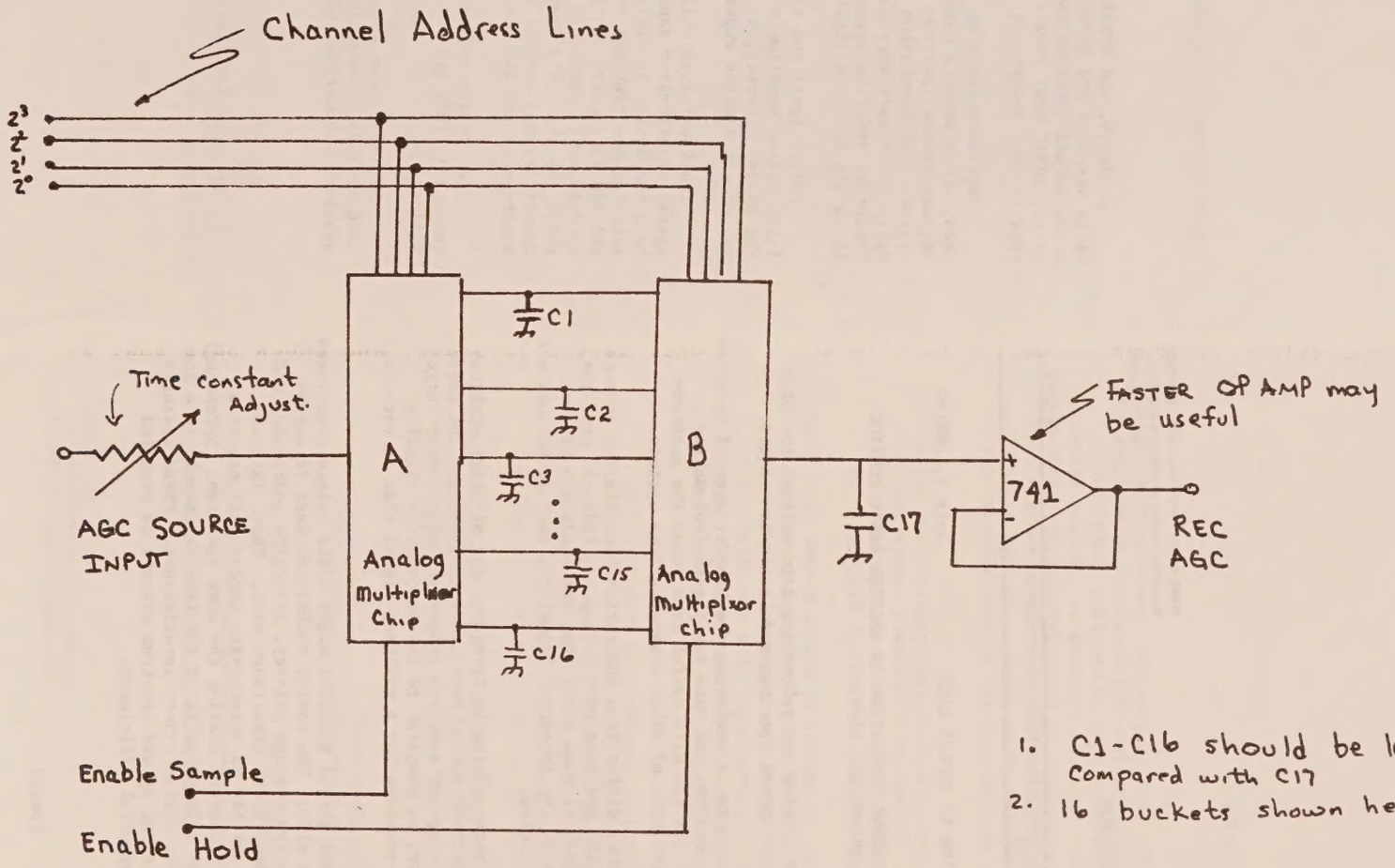
4. Make sure that the maximum agc voltage does not exceed the plus power supply nor the minimum agc voltage exceed the negative power supply voltage.

5. The principle of operation is that each of the capacitors (C1 - C16) operates as an analog storage device. When multiplexor A is active it selects one of the links between the two multiplexor chips and connects it to input 1 (the agc source). The result is that the capacitor connected to that link is charged up to the agc source voltage. When chip A's enable goes low, it resembles an open circuit with just a charged capacitor on it. Then, when the chip is enabled, the agc voltage level which is stored in the charged capacitor is made available to the receiver via the 741 op amp and capacitor C17.

LITERATURE

There is quite a bit of spread spectrum information in a new book Principles of Military Communications Systems by Dr. Don J. Torrieri, published by Artech House, 610 Washington St, Dedham, MA 02026. If anyone can find the $45 to buy it and the time to read it (or any other SS literature), please let us know your comments.

□



1. C1-C16 should be large compared with C17
2. 16 buckets shown here.

SPREAD SPECTRUM

SAMPLE AND HOLD FOR AGC

AUTHOR
K4IHP

FCC NEWS
FEDERAL COMMUNICATIONS COMMISSION
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001898

Report No. 16449 ACTION IN DOCKET CASE July 1, 1981-G

INQUIRY BEGUN ON SPREAD SPECTRUM MODULATION IN AMATEUR RADIO SERVICE
(GEN. DOCKET NO. 81-414)

The Commission has begun an inquiry and rulemaking into whether to allow certain amateur radio users to use spread spectrum modulation techniques.

In another action, the Commission is exploring the broader area of wideband technologies, including spread spectrum, and said the inquiry/rulemaking involving amateurs would provide the FCC with useful data about the performance of such techniques in the presence of other communications systems.

Wideband modulation techniques differ from conventional modulation schemes --such as amplitude modulation (AM) and frequency modulation (FM)--in that the bandwidth of the transmitted signal is much wider than the bandwidth of the information being sent. Because of the increased bandwidth, such techniques are implicitly prohibited by current rules.

Spread spectrum techniques were originally developed for military applications concerning covert communications and/or resistance to jamming. The radio frequency signal transmitted in a spread spectrum system occupies a very large bandwidth, perhaps many megahertz, as compared to the information signal's bandwidth. This wide bandwidth provides for a military signal that is very hard to detect or jam.

The Commission concluded that spread spectrum might offer unique advantages to civilian communications users also. The coding techniques used in spread spectrum systems, for example, allow message privacy, selective addressing and code division multiple access (many users simultaneously). These last two advantages provide the user the ability to selectively access only one or a fraction of the total number of receivers sharing the same spectrum. Spreading the signal at the transmitter and collapsing it at the receiver result in a low signal power density and helps the system reject interference. These features suggest the feasibility of overlaying spread spectrum systems on occupied spectrum, leading to increased spectral efficiency.

(over)

In March, the Commission's Private Radio Bureau authorized the Amateur Radio Research and Development Corporation (AMRAD) to conduct limited tests using spread spectrum modulation. When this special temporary authority expires, AMRAD must submit its findings to the Commission, which will consider them in this proceeding.

Experimentation will be to limited Amateur Extra and Advanced Class licensees, whose members have been tested in advanced phases of radio electronics. Because spread spectrum systems are inherently more complex than narrowband systems, the Commission said these licensess were best qualified to build and operate the necessary equipment so as not to interfere with other radio users. (Material covering spread spectrum techniques will be added to future Amateur Extra and Advanced class tests.)

Due to legal and technical considerations, the Commission proposes authorizing spread spectrum modulation only in the 50-54 MHz, 144-148 MHz and 220-225 MHz bands. However, it welcomes requests for special temporary authority to perform limited experiments in the amateur bands above 225 MHz.

The Commission will not limit system design, but only proposes that a system's authorized bandwidth be equal to or less than the width of the amateur band the system is operating in and be contained within that band. Although no interference problems are anticipated, local engineers-in-charge will be allowed to require stations transmitting spread spectrum signals to cease operation, if necessary to stop interference. Provisions to facilitiate monitoring by the Field Operations Bureau and by other amateurs are proposed. Commenters may address the issue of interference potential in overlaying spread spectrum on the three aforementioned bands.

The inquiry notice lists questions that might guide those wishing to comment in this proceeding. Interested persons should obtain a copy of the notice.

Action by the Commission by Notice of Inquiry and Proposed Rulemaking (FCC 81-290). Commissioners Fowler (Chairman), Lee and Quello, with Commissioner Washburn concurring and issuing a statement.

-FCC-

For more information contact Mike Kennedy at 202-632-7073).

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Report No. 16450 ACTION IN DOCKET CASE July 1, 1981-G

FCC SEEKS COMMENT ON SPREAD SPECTRUM/WIDEBAND MODULATION TECHNIQUES
(GENERAL DOCKET NO 81-413)

The Commission has begun an inquiry into wideband modulation techniques, particularly examining whether spread spectrum modulation systems may offer advantages to some radio users and bring about increased spectrum-use efficiency.

With this inquiry, the Commission is gathering information to help it identify specific radio services now authorized by the Commission as well as ideas for new services, where the authorization of wideband modulation techniques would serve the public interest; and identify the technical parameters that characterize a wideband emission, including procedures to measure these parameters, and identify technical standards necessary to ensure minimal interference.

Wideband modulation techniques differ from conventional modulation schemes --such as AM (amplitude modulation) and FM (frequency modulation)--in that the bandwidth of the transmitted signal is much wider than the bandwidth of the information being sent. (Basically, modulation involves varying some characteristic of a radio frequency carrier so that an information signal can be transmitted. Bandwidth is a measure of the amount of spectrum used by a signal.)

With limited exceptions, the Commission now implicitly prohibits the use of these emerging technologies because of the large bandwidth requirements. It has received requests to authorize systems using wideband modulation techniques for such diverse services as communications, radiolocation and telemetry operations.

One wideband technology that may have beneficial civilian applications is spread spectrum modulation. Spread spectrum technologies have been evolving since the 1940s, primarily in military and aerospace environments, where they have provided resistance to jamming, resistance to unintentional interference, resistance to unauthorized interception, accurate distance or location measurements and sharing of a common radio frequency band by multiple users, among other features. These properties, especially the dual prospects of multiple use and increased spectrum efficiency, might benefit civilian communications users also.

(over)

The Commission voiced concern about its ability to monitor and locate spread spectrum modulated stations. Because the emitted signal is both wideband and encoded, special receivers are needed to demodulate (recover) the information signal. Another monitoring problem is the large number of virtual "channels" created.

However, it said the monitoring problem perhaps could be mitigated in the way user codes are assigned, that spread spectrum systems could be authorized in services that have had few enforcement problems and only spread spectrum techniques that can be decoded with a conventional wideband receiver might be authorized. Finally, considering the low interference potential of spread spectrum emissions, the Commission noted, signals strong enough to cause interference will probably be strong enough to locate.

The MITRE Corporation prepared a report, "Potential Use of Spread Spectrum Techniques in Non-Government Applications," under contract to the FCC, that indicates spread spectrum, while not a panacea for the increasing demand for spectrum space, may have useful applications, particularly where uncoordinated channel access by a significant number of users is required. The land mobile services represent such users. The results of this study will be inserted in the record of this proceeding and some of the questions on which comment is sought are addressed to it.

A 1978 report by the ITT Research Institute for the Defense Department developed procedures for analyzing interference caused by spread spectrum signals. The Commission seeks comment on the appropriateness of using this report as a basis for rulemaking.

Besides commenting on the MITRE Corporation and ITT Research Institute reports, the public may also suggest measurement techniques to evaluate the interference potential and technical characteristics of spread spectrum and other wideband systems and suggest services that might benefit from wideband modulation techniques.

Those wishing to comment on this proceeding should obtain a copy of the order containing the questions that typify the Commission's concerns. Information not directly responsive to the questions but relevant to the inquiry subject are welcome.

Action by the Commission June 30, 1981, by Notice of Inquiry (FCC 81-289). Commissioners Fowler (Chairman), Lee, Quello and Washburn.

-FCC-

For more information contact Mike Kennedy at 202-632-7073.

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Report No. 16454 ACTION IN DOCKET CASE July 1, 1981-G

INLAND NONGOVERNMENT RADIOLOCATION USING SPREAD SPECTRUM TECHNIQUES PROPOSED
(GEN. DOCKET NO. 80-135)

The Commission has proposed allowing inland expansion of nongovernment radiolocation operations in the 420-450 MHz band by pulse-ranging systems, including those using spread spectrum technology.

The Commission would amend Parts 2 and 90 of its rules to allow nongovernment radiolocation in the 420-450 MHz band in Alaska and the contiguous 48 states on a secondary, non-interference basis to government radiolocation and the Amateur Radio Services. Authorizations would be granted case-by-case with particular attention given to the proposed power and antenna system requirements. These operations would be excluded in certain military areas.

Previously, the FCC allowed nongovernment radiolocation only along the shore lines of Alaska and the contiguous 48 states for applications such as mapping offshore areas for oil exploration, precisely determining drilling locations and measuring for hydrography research.

In response to the second part of a petition by Del Norte Technology, Inc., a radiolocation equipment manufacturer, the Commission now proposes to expand nongovernment radiolocation in the 420-450 MHz band inland to permit its use for agricultural, forestry and aerial surveying applications. Several commenters support this proposal. The first part of the petition involved deleting a cutoff date for assigning frequencies in the 420-450 MHz band for nongovernment radiolocation and was adopted last November.

Del Norte also asked the Commission to permit the use of spread spectrum modulation, a wideband technology originally developed for military applications. Because of bandwidth requirements, the Commission has implicity prohibited the use of wideband technologies. However, it has just begun an inquiry on spread spectrum and other wideband techniques to see whether commercial users would benefit. In military and aerospace use, spread spectrum has provided resistance to jamming, to unintentional interference and to unauthorized reception; accurate distance and location measurements; and sharing of a common radio frequency band by multiple users.

The Commission invites comment on whether an interference standard should be included in the rules, whether station identification should be required of spread spectrum systems and seeks comment about the necessity and techniques for monitoring and identification related to the use of spread spectrum for radiolocation.

Action by the Commission June 30, 1981, by Further Notice of Proposed Rulemaking (FCC 81-291). Commissioners Fowler (Chairman), Lee, Quello and Washburn.

-FCC-

For more information contact Sam Tropea at 202-653-8167.

June 30, 1981

CONCURRING STATEMENT OF COMMISSIONER ABBOTT WASHBURN

re: Notice of Inquiry and Proposed Rule Making to Amend Parts 2 and 97 of the Commission's Rules and Regulations to Authorize Spread Spectrum Modulation in the Amateur Radio Service

The second paragraph of this item states: "we feel comfortable proposing the authorization of spread spectrum modulation". I do not share this feeling of comfort when the same document includes the following language: "A major concern of the Commission in allowing amateur use of spread spectrum techniques is the Commission's, and the amateur's own, ability to monitor and locate stations transmitting wideband emissions". So there is no real control. While new technology is to be encouraged, especially that which allows more use of the spectrum, this should not be at the price of interference. There must be assurance that expanded use of this technology will contribute to the effective and efficient use of the spectrum while at the same time not adding interference to the detriment of other technologies and spectrum users in general.

In a related Notice of Inquiry adopted today, the Commission initiated a proceeding seeking information regarding the future authorization of spread spectrum and other wideband emissions not presently provided for in our Rules. That inquiry requests information and data regarding the technical characteristics, efficient use of spectrum, possible standardization, potential applications of this technology, etc. It also raises questions regarding the measurement of interference potential, emission testing and the necessity for Commission monitoring. With issues such as these still in the initial and infant stage of information gathering, the Commission seems to be prejudging important issues by rushing to Rulemaking. A more prudent approach would be first to obtain the facts on monitoring and interference via the NOI, assess these facts, and then move to Rulemaking. However, we are assured by the staff that the risks involved will be minimal. I hope this proves to be the case.

PROTOCOL

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NEWS

A new book, "Packet Radio," by Robert Rouleau, VE2PY and Ian Hodgson, VE2BEN has just been published by Tab Books Inc., Blue Ridge Summit, PA 17214, for $11.95 in paperback. (Tab Books was kind enough to send us a copy for the AMRAD library.) I am just getting into the book which apparently advocates the Montreal method (2400 baud asynchronous afsk, 2400 Hz mark, 4400 Hz space, 233.050 MHz using Midland 13-509 220-MHz FM transceivers). The Montreal system is not directly compatible with the Vancouver/AMRAD type system, but gateway nodes will no doubt be constructed to allow the two packet users to communicate. The interesting part of this book at first glance is the simple modem circuit provided which allows XR-2206 and XR-2211 inexpensive construction. I am sending a copy of the circuit to Sandy, WB5MMB who is working on the modem problem. The book is available in Heathkit stores generally.

I have been working with Hank Magnuski, KA6M to alleviate the VADCG printed-circuit board shortage problem. The Canadian postal strike has precuded getting any more boards from Canada quickly. Hank is checking into San Francisco production of the board which would decrease order time for new packeteers. AMRAD will take 25 boards of the first run. Beyond that, I am looking into doing a new board with more RAM that can run faster. AMRAD advocates running 48 kilobaud on 220 MHz to link between cities (Special Temporary Authority or rules change would be required), but the VADCG board will not do this directly by increasing the clock speed and buying faster RAM. To revisit old arguments, higher packet speed is required to increase throughput and to allow more users on the channel by means of time-division multiplexing.

HF PACKETS

Under great duress, I was convinced to purchase an ICOM IC-701. It is great for hf. Great is defined as computer compatible. Now, if I can just get past the feedline and antenna problem (always a sore point at K8MMO) with the help of WB5MMB and W4RI, I will be packeteering on 14.076 MHz, 2125 Hz mark and 2295 Hz space using my ST-6A to begin 75-baud operation. This required some work on the Terminal Node Controller board as follows:

The clock divider chip, previously a 4024 seven-stage divider, has to be changed to a 4040 twelve-stage divider as outlined in my previous Protocol column (June 1981). This allows packet (line) speeds of 75 baud to 4800 baud.

In addition, Americans have an additional problem of cw i-d (voice is allowed, but it is not practical for packet) of 20 wpm or less. Hank Magnuski, KA6M has provided AMRAD with his cw i-d 8085 source code which allows the 8273 (protocol chip) on the TNC board to be placed in bit-transparent mode for the i-d function. This is an improved version of the beacon program previously supplied by Doug Lockhart, VE7APU. I changed the code to allow the cw speed to be selected at sign-on initialization time to allow vhf types to switch to hf when that is desired. Now with the new code, turn-on/reset of the TNC board will produce the following:

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VADCG LIP-M02B TIP-M01B

SWITCH? 1=4800 2=2400 3=1200 4=600 5=300
6=150 7-75
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Upon seeing the above prompt for SWITCH?, you must enter the number of switch you have closed for packet (line) speed. The appropriate cw speed i-d will then be chosen by the software. This will allow us to begin cross-country hf work with the ARRL (W1AW) in Newington, Hank Magnuski (KA6M) in San Francisco, Wally Lindstruth (WA6JPR) in Los Angeles and Doug Lockhart (VE7APU) in Vancouver. I would liek to accomplish something in this regard before the October networking conference.

STATUS OF AREA STATIONS

K8MMO, WB4JFI and W4MIB are on vhf with VADCG boards and Bell 202 modems. W4RI, W1AW, W4CQI and WB5MMB have completed VADCG boards and are working on modems. □

THE DEAF AND THE TTY

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HIGHLIGHTS OF THE TDI CONVENTION

The 4th International Convention of the Telecommunications for the Deat, at Kansas City, is now history. But it is hoped that the message conveyed to the conventioneers on the features of computer and radio telecommunications will not be lost on them. AMRAD president, Paul Rinaldo, was one of the conventioners as well as one of the speakers on the Computer Telecommunications panel. He was besieged by interested computer enthusiasts for advice on adapting their home gear for computer and radio communication uses. Several conventioneers have had experience with radio TTY apparatus and were especially thrilled to learn of the opportunities in this field for them.

The Computer Telecommunications panel featured four speakers, all of them relating their expertise with different aspects of communications. Ken Harrenstien, of SRI International, explained what DEAFNET was all about. Then came Hartmut Teuber, TDI vice president (a native of West Germany but a resident in the the United States for the past 15 years) explained what GTE Telemail was all about. In another workshop, he also explained the differences between different television text systems in Europe and in the United States - Teletext, Ceefax and others.

Coming up was Marie Lattin-Souder, of Charlottesville, VA where the National Crisis Center for the Deaf is based. She gave an overview of how an Apple II is being used as a TDD to handle all calls. Then Rinaldo explained what AMRAD was about and its plans for the deaf in the near future.

At the TDI booth, conventioneers were especially fascinated with the ability of the Apple II to perform as a TDD. In that exhibit hall were two TDD manufacturers (Ultratec and Krown Research) which showed off their TDDs functioning as Bell 103 modems, too. They were being studied very closely by other competing TDD manufacturers, whom for one reason or another were loathe to add Bell 103 capabilities to their devices.

The conventioneers were especially impressed with the high speed of electronic communications when a recipient of a TDI award was unable to be present. The message was conveyed to him via the conventional, but much slower, telegraph system. This excited winner informed his friends of this honor. One of his friends then sent in a message via GTE Telemail confirming receipt of this award. This exchange of high-speed communications left a mark on those that witnessed it.

At the workshop for TDI agents, known as the mainstays of the organization for their experience with model 15, 28 and 32 machines, an indoctrination was given them on the nuances of the ASCII world. They had heard about it. They had read about it. They had talked about it. But it was a subject still foreign to them. However, their attitude was receptive because they know rather painfully that Baudot machines have become harder to get these days.

TDI is the first national deaf organization to have its officers and home office utilize electronic mail for rapid daily communications. The new president, new vice president, the executive director, and two other directors are interlinked via GTE Telemail. Other deaf-run national organizations still rely on the mails and on the telephone to reach each other. This is the message that TDI vows that will not be lost on the deaf communities.

The next TDI convention will be held at Philadelphia in 1983. At Atlanta in 1979, Bob Bruninga introduced the marvels of a computer bulletin board. This 1981 convention showed how much progress has been made. It would be exciting to see what will be on the horizon by the time the 1983 convention comes around.

It might seem old hat to computer and radio hobbyists, but it is a new and exciting, as well as confusing, world to the deaf. □

THE HANDICAPPED EDUCATION EXCHANGE (HEX) is updating its data base on education of, and communication with, the handicapped. If you have items, enter a message on HEX at 301-593-7033 or mail to Dick Barth, 11523 Charlton Dr, Silver Spring, MD 20902.

Data Communications with Forward Error Correction

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While packets, using an error-detecting code only, are probably a good approach to computer-to-computer communications on VHF channels (where the channel quality is similar to a telephone line), they will probably not be too efficient on poor hf channels. The high error rate of the channel will cause many packet retransmissions and also probably force the use of very short packets. These will both greatly reduce system throughput.

For use on very poor hf channels, I have been working on an approach to error-free data communications that uses forward error correction and shorter block lengths. The basic encoder/decoder software has been developed, and the modules to implement full link protocols are under development. At this point I am looking for other interested amateurs to establish similar capabilities to exchange data blocks using this scheme so that we can evaluate its effectiveness under real conditions. The following article outlines the approach I am advocating.

I am using conventional asychronous ASCII RTTY and doing all coding functions in software. I have chosen a twice-interleaved Reed-Solomon code of length 15 to encode each data block. This code takes 9 information bytes (8 bits each), computes 6 check symbols, and sends the 15 bytes as a block. The use of 6 check symbols allows the decoding software to correct up to 3 errors anywhere in the block, and to detect a bad block when more than 3 errors occur. The obvious advantage of this approach is that the system can now tolerate a channel error rate of 3 out of 15 (20%) and still produce error-free output with no block retransmissions. When the decoder cannot correct a block, the system will request a retransmission of that block. Under bad conditions, when errors are likely, this scheme should perform better than a packet system where error detection only is used.

The block format that I am using now has evolved over several months via testing in simulated one-way transmissions with high noise levels and seems to be devoid of bad traits. The first byte of each block is a start flag (55H), which is followed by an 8-bit block address. The use of an 8-bit address allows the transmitting station to send up to about 256 blocks per transmission before pausing for block acknowledgements from the receiving station. This allows transmissions of several minutes duration, which is more convenient (with hf gear) than sending single packets and waiting for an acknowledgement. The following 7 bytes of a block are the *data*, and the final 6 bytes are the check symbols. The receiving station computer uses the block addresses to assemble the blocks in the proper sequence after they are received error-free to form the completed *message*.

Local tests of the software were first conducted using tape recorded block sequences with additive noise from an hf communications receiver to produce errors. On June 8, 1981, a prepared tape of ASCII data blocks at 110 bits/s was transmitted from WB8ICL in Ohio to W9JD/2 in New York on 80 meters to test the system under true hf channel conditions. The results were very similar to those of the local tests.

Under bad conditions, when errors are occurring in most or all blocks, the system is able to fully correct many of the blocks, while remaining uncorrectable blocks are (usually) flagged as bad. I say usually because there is a small, but non-zero, probability that a garbled block will appear at the decoder to be another, but wrong, valid block. This phenomenon is the same that occurs with the cyclic redundancy check used in the packet format. The actual probabilities involved are such that when this forward error correction system is being used to actually attempt to correct 3 errors per block, its bad block detection capability is about 100 times less than that for the 16-bit CRC of a packet. The decoder has been designed to allow this probability to be improved by restricting the decoder to attempting correction of fewer errors. because the same number of check symbols are still being used, the probability of not detecting a bad block decreases rapidly, to the point that the probability is 10,000 times better than that of the 16-bit CRC when an error-detecting only mode is chosen. In this way, depending upon the nature of the data being transferred, the operators can choose either error correction and higher throughput at the expense of increased chances of a bad block slipping by undetected, or being very conservative, correcting few or no errors and being very confident that bad blocks will be detected and retransmitted.

This system promises to be more effective than packets over hf channels and also over satellite channels where the long transmission delay of the satellite path reduces throughput due to the acknowledgement required after every packet.

continued→

It may also be very beneficial to use a scheme like this, in conjunction with local packet networks, for transmission of packets from one isolated packet network to another when hf or satellite paths are to be used. The packet could simply be broken up into the smaller blocks required for this code and transmitted point to point, then re-assembled into a packet at the receiving station (a *gateway*), and introduced into the destination packet network. In this way, large packets appropriate for high quality local vhf channels could be simple transmitted long distances over channels that would otherwise require much shorter packets.

I have developed the encoding and decoding software routines on my Digital Group Z-80 computer in assembler language. I would like to get together with others who are interested in setting up a capability to link computers using this coding scheme and am willing to freely share all that I know about it, and my software. While it will be simplest to cooperatively develop and share software with other Digital Group Z-80 users anyone who is willing to translate the existing software onto their own machine is, of course, welcome. I would like to see a group of 3 to 5 of us working together on 80, 40 or 20 meters and testing out various link protocols for highest effectiveness. If interested, please write to me directly.

Ed. Note: You can count me in on your hf testing. I have an IC-701, VADCG protocol board, a H-19 terminal plus S-100 system on the way. K8MMO has a similar system and may be able to take on the code conversion from Digital Group to S-100/CP/M. I'm sure that W1AW will want to participate; they should have their hf/packet ready to go on the air about the time you read this. □

CORRESPONDENCE:

AMRAD:

I was the financial half of a business partnership that was dissolved after both parties found better paying jobs. I am attempting to liquidate our business' assets through sale of the following:

S-100 Computer System including:
Main frame with 15 sockets, keyed-up 8080 CPU/front panel, 10-A power supply with fan, VB-1 video board, active termination.
Thinker Toys Discus 2+2 with DJ 2 drive controller, CPM, Disc-Ate and 10 extra discs.
Teletek System Central Interface I/O with 2708 programmer and system monitor for 8080, VB-1. Sony C-104 cassette recorder. Three Proc. Tech. 16KRAs. Complete system is assembled & tested. $2150.
EPROM Programmer Optimal Technology EP-2A-7918 with personality modules for TMS 2708/2716/2532: 2708, 2716, 2732. Factory assembled and tested. Unused $220.
Thinker Toys Switchboard I/O with optional 2114 RAM. $220.
DRC 16K EPROM Card with 2708 EPROMS $110.
SD Sales 4k Low Power RAM $65.
Card Extender $15.
Wunderbuss 12-slot kit $40.
Digital Multimeter, Data Precision Model 3500, 5 1/2 digits, $450.
DC Secondary Voltage Standard, Analogic Model AN3100 with certificate of conformance. $600.

All equipment is in excellent condition. I travel frequently to the DC Metro Area and can arrange to meet any of your club members who may be interested.

Michael D. Fay, K1FUL
26 Upper Trail
Fairfield, PA 17320
717-642-8850 evenings

Dear Paul,

I received the AMRAD Newsletters and CBBS Directory from you yesterday. To tell the truth, I could not put them down 'til I had read them through. Several times I have seen the ads for the newsletter and thought that would be interesting but did not get around to sending for it.

Paul, I have a TRS-80 which I use on RTTY with the M80/M800. I am interested in the packet thing but I do not have a lot of knowledge of the digital stuff. Could you tell me how a guy gets started into this stuff from the ground floor. The VADCG board looks interesting. I have no doubts that I could build the thing but I would not have the slightest idea how to hook it up unless they would say something like pin 1 on the board goes to data line 2 or something like that.

Well what I wanted to say was thanks very much, Paul, and I will sure be putting in the plug for your group and will also be looking forward to the next newsletter from AMRAD.

de WA9WJG, John

Ed. Note: You've taken a first step by joining AMRAD and reading our newsletter. It would also be helpful for you to join VADCG and reading The Packet; $10 to Don Oliver, VE7AOG, 818 Roundeau St, Coquitlam, BC Canada V3J 5Z3. You might also want to join the Hamilton and Area Packet Network. HAPN publishes I-Frame de VE3PKT. Send $10 to Stu Beal, VE3MWM, 2391 Arnold Crescent, Burlington, ON Canada L7P 4J2. Also, look for an article by K8MMO and W4RI on packet radio networking in the October QST.

THE NATIONAL COMPUTER SHOWS will be held this year in Chicago, Washington DC, Boston and Atlanta. They are public expositions for manufacturers, OEMs, dealers, etc. The Second Annual Mid-Atlantic Computer Show & Office Equipment Exposition will be staged at the DC armory September 24-27. Shows at the other cities will be: Chicago, September 10-13; Boston, October 15-18; and October 29 - November 1 at the Atlanta Civic Center. For info about attending, or exhibiting at, the shows, call or write National Computer Shows, 824 Boylston St, Chestnut Hill, MA 02167. Or you can call NCS president, Gerald A. Milden on 617-739-2000.

A 46-KBYTE BUBBLE MEMORY FOR THE S-100 has been announced by Bubbl-Tec Division of PC/M Inc., 6800 Sierra Ct, Dublin, CA 94566, 415-829-8700. The MBC-100 Bubbl-Board and one or more MBB-100 Bubbl-Pacs make up a system which requires less than 25 W to operate. Each MBB-100 contains 46 kbytes of storage and costs $772 in 100 quantity. The MBC-100 controller can control up to 16 MBB-100. The MBC-100 costs $361 in 100s.

THE COMMUNITY COMPUTERIST'S DIRECTORY has been announced by its editor, Jeff Love, PO Box 405, Forestville, CA 95436, 707-887-1857. It includes white pages and yellow pages for listing individual computer hobbyists and computer businesses. Listings cost $10 per 500 words in the white pages, double that for yellow pages. Copies of the directories are available at $3.50 each.

AN 8-BIT SLICE CMOS PROCESSOR CHIP SET has been announced by RCA Solid State Division, Rt 202, Somerville, NJ 08876, 201-685-6423. This new GP Series chip set can be used to emulate other existing computers with established software as well as for entirely original computer architecture. The set will include: an 8-bit slice processor unit; an emulating controller; a microprogram sequencer similar to industry standard 2910 bipolar unit; and an 8x8 multiplier. RAM, ROM and gate universal array ICs support these circuits. Contact RCA for more details.

MICRO-GRIP FRICTION FEED FOR EPSON MX-70 and MX-80 converts these printers for friction feed of single sheets or roll paper. $39.95 +1.50 postage from Micro-Grip, Ltd, P.O. Box 873, LAFB, VA 23665.

DESIGNING MODERN POWER AMPLIFIERS is a 2-day McGraw-Hill/Electronics course lead by Dr. Frederick H. Raab. The seminar will cover linear amplifier types A & B plus rf and switching types C, mixed-mode C, D, E, F and S. Places and dates are: (Fee $495)

- New York, August 24-25
- Chicago, October 28-29
- San Francisco, November 12-13
- Boston, January 25-26.

Write McGraw-Hill Seminar Center, 305 Madison Ave, Rm 3112, New York, NY 10017 or call Carol Clark at 212-687-0243. They offer other courses at the above locations as well as Los Angeles, Atlanta, Houston, Washington and Toronto.

HAL COMMUNICATIONS CORP., Box 365, Urbana, IL 61801, 217-367-7373 is offering a CT2100 communications terminal. With video monitor and keyboard (not supplied) it is a complete transmit/receive terminal for Morse, Baudot and ASCII RTTY. It includes 5 demods (170-, 425-, and 850-Hz shifts with both U.S. standard high tones and IARU low tones; Bell 103; and, Bell 202).

FLYERS ARE AVAILABLE ON INFONE from Novation, 18664 Oxnard St, Tarzana, CA 91356, 213-996-5060. Infone is a portable terminal which operates 300 and 1200-baud ASCII using Bell 103 and 202 modems as well as 45-baud Baudot Weitbrecht (deaf tones).

UTILIZATION OF THE SPACE SHUTTLE is a short course to be given September 21-24 ($645) at GWU, Washington, DC. Contact Director, Continuing Engineering Education Program, George Washington University, Washington, DC 20052, 202-676-6106 or toll free 800-424-9773.

AMRAD **Amateur Radio Research and Development Corporation**

Membership Application/Renewal

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1206 Livingston St N
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See reverse for overseas mailing rates.

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I agree to support the purposes of the Corporation.

*Signature*_____

THE AMATEUR RADIO RESEARCH AND DEVELOPMENT CORPORATION is a technically oriented club of about 400 radio and computer amateurs. It is incorporated in the Commonwealth of Virginia and is recognized by the Internal Revenue Service as a tax-exempt scientific and educational organization.

THE PURPOSES OF THE CLUB are to: develop skills and knowledge in radio and electronic technology; advocate design of experimental equipment and techniques; promote basic and applied research; organize forums and technical symposiums; collect and disseminate technical information; and, provide experimental repeaters.

MEETINGS ARE ON 1st MONDAY of each month at 7:30 p.m. at the Patrick Henry Branch Library, 101 Maple Ave E, Vienna, VA. If the 1st Monday is a holiday, an alternate date will be announced in the *AMRAD Newsletter*. Except for the annual meeting in December, meetings are normally reserved for technical talks - not business.

THE WD4IWG/R REPEATER is an open repeater for data communications (including RTTY), voice and experimental modes. It is located at Tyson's Corner, McLean, VA and has excellent coverage. It features a semi-private autopatch available to licensed members. Frequencies are: 147.81 MHz input, 147.21 MHz output. The head of the technical committee is Jeff Brennan, WB4WLW, 7817 Bristow Dr, Annandale, VA 22003, phone 703-354-8541.

THE AMRAD NEWSLETTER is mailed monthly to all members and to other clubs on an exchange basis. Technical articles, new product announcements, news items, calls for papers and other copy related to amateur radio and computing are welcome. Honorariums at a rate of $10 per printed page ($20 maximum per author per issue) are paid for original material accepted. Classified ads are free to members. Commercial ad inquiries are invited. The editor reserves the right to reject or edit any portions of the copy. Items should be mailed by the 8th of the preceeding month to Paul L. Rinaldo, W4RI, Editor, 1524 Springvale Ave, McLean, VA 22101; phone 703-356-8918. Full permission for reprinting or quoting items appearing in the *AMRAD Newsletter* is granted provided that credit is given. Mailing is by 3rd Class bulk mail to U.S. addresses and 1st Class to Canada and Mexico. Overseas readers add 96¢ for surface or $7.80 for air mail to annual dues.

THE AMRAD MESSAGE SYSTEM is an S-100 Computerized Bulletin Board System on 703-734-1387, system operator Terry Fox, WB4JFI. Terry's home phone number is 703-356-8334. The system accepts 110, 300, 450 and 600 baud ASCII callers using Bell 103-compatible modems.

THE HANDICAPPED EDUCATION EXCHANGE (HEX) is operated by AMRAD for those involved in education and communications for the handicapped. It accepts both 110/300-baud ASCII and deaf TTY callers. on 301-593-7033. The sysop Dick Barth, W3HWN's home phone is 301-681-7372.

AMRAD OFFICERS for 1981 are:

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THE AMRAD LIBRARY is operated by Tedd Riggs, KC4YN, 8402 Berea Ct, Vienna, VA 22180, phone 703-573-5067. Donations of technical books, magazines, manuals and catalogs are tax-deductible.

AMRAD IS AFFILIATED with the American Radio Relay League (ARRL), the Foundation for Amateur Radio, the Northern Virginia Radio Council (NOVARC) and The Mid Atlantic Repeater Council (T-MARC).

SPECIAL INTEREST GROUPS are formed from time to time. Currently we have SIG's on Deaf Communications and Spread Spectrum Communications. If you are interested in joining or forming a SIG, please contact Bill Pala, WB4NFB, 5829 Parakeet Dr, Burke, VA 22015; phone 703-323-8345.

TRAINING CLASSES are run as needed. Please discuss your training requirements with any Director.

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